Claims

1. (Currently amended) A signal processing method for enhancing a demodulation performance of CDMA receiving system utilizing an array antenna, the method comprising the steps of:

a) producing array outputs, by means of products between a weight vector at present snapshot and each of Walsh demodulation outputs;

b) selecting an index number of an array output having a largest magnitude ~~in such a way that a magnitude of a selected array output is largest~~ of all array outputs, and

c) updating the weight vector by using a Walsh demodulation output vector which corresponds to the index selected in the step b).

2. (Original) The signal processing method as recited in claim 1, further comprising the step of:

d) returning back to the step a) with a current value of the weight vector at the present snapshot being kept as an initial value to be updated at a next snapshot for continuing the signal processing method at the next snapshot, after the step c).

3. (Original) The signal processing method as recited in claim 1, wherein the Walsh demodulation outputs, $\{ \underline{x}_k \mid k = 0, 1, 2, ..., 63 \}$, in the step a), are generated as results of 64 correlations of a received signal vector, with the 64 Walsh words defined in the CDMA receiving system, where N is the number of antenna elements in a given array

antenna, such that each of the Walsh demodulation outputs can be written as $\underline{x}_0 = [x_{0,1}\ x_{0,2}\ \ldots x_{0,N}]^T$, $\underline{x}_1 = [x_{1,1}\ x_{1,2}\ \ldots x_{1,N}]^T$, …, $\underline{x}_{63} = [x_{63,1}\ x_{63,2}\ \ldots x_{63,N}]^T$, where the component $x_{i,j}$ is obtained through the Walsh demodulation of the received signal with i_th Walsh word at the j_th antenna channel.

4. (Currently amended) The signal processing method as recited in claim 1, wherein the step c) includes the steps of:

cl) converting the index number of an array output ~~a quantity of the index D,~~ obtained in the step b) into the corresponding 6-bit binary number in order to retrieve an original data transmitted from mobile terminal; and

c2) updating the weight vector vector~~, $\underline{w}_D$~~ based on ~~utilizing~~ the Walsh demodulation output corresponding to the index number of the array output ~~D, $\underline{x}_D$,~~ in order to process the received signals at for the next snapshot ~~period~~.

5. (Currently amended) The signal processing method as recited in claim 4, wherein the step c2) includes the steps of:

c2-l) updating an autocovariance matrix of received signals with the Walsh demodulation output corresponding to the index number of the array output ~~D, $\underline{x}_D$,~~ such that the autocovariance matrix is determined by an equation as:

$$\underline{\underline{R}}_{xx} = E[\underline{x}_D\ \underline{x}^H{}_D]$$

where $\underline{\underline{R}}_{xx}$ is an autocovariance matrix, $E[\ ]$ denotes an expectation operator, D denotes an index number of an array output having a largest magnitude in all array outputs, $\underline{x}_D$ denotes a weight vector and superscript H denotes a Hermitian operator; and

c2-2) computing an eigenvector corresponding to a largest eigenvalue of the autocovariance matrix obtained in the step c2-1) and use it as the weight vector.

6. (Currently amended) The signal processing method as recited in claim 4, wherein the step c2) includes the steps of:

c2—1) updating an autocovariance matrices of the received signal[[s]] vector obtained before the dispreading procedure and the Walsh demodulation output after the despreading ~~dispreading~~ procedure through mathematical operations as:

$$\underline{\underline{R}}_{rr} = E[\underline{r}\ \underline{r}^H] \text{ and}$$

$$\underline{\underline{R}}_{xx} = E[\underline{x}_D\ \underline{x}^H{}_D], \text{ respectively}$$

where the received signal vector obtained before the despreading ~~dispreading~~ procedure is defined as $\underline{r}$ is defined as $\underline{r} = [r_1\ r_2\ \dots\ r_N]^T$ with the superscript T being the transpose operator in a matrix and r_i being defined as the received signal at the i_th

antenna element, i.e., $\{r_i = r_{I,i} + j\ r_{Q,i}$ for $i = 1, 2, \ldots, N\}$ and $r_{I,i}$ and $r_{Q,i}$, and the received signal vector $\underline{x}_D$ is itself the output of the Walsh demodulator; and

c2-2) updating the weight vector with an eigenvector corresponding to a largest eigenvalue in a generalized eigenvalue equation consisting of the autocovariance matrices of received signal[[s]] obtained before the despreading procedure and the Walsh demodulation output after the despreading dispreading procedure through the mathematical operations as:

$\underline{\underline{R}}_{rr} = E[\underline{r}\ \underline{r}^H]$ and

$\underline{\underline{R}}_{xx} = E[\underline{x}_D\ \underline{x}^H{}_D]$, respectively,

as mentioned in the previous step c2-1) such that the weight vector $\underline{w}_D$ is eventually computed from the generalized eigenvalue equation, $\underline{\underline{R}}_{xx}\ \underline{w}_D = \lambda_{MAX}\ \underline{\underline{R}}_{rr}\ \underline{w}_D$, where λ_{MAX} denotes the largest eigenvalue of the given generalized eigenvalue equation.

7. (Original) The signal processing method as recited in claim 1, wherein the CDMA receiving system includes an IS95 CDMA base station receiver utilizing an array antenna.

8. (Original) The signal processing method as recited in claim 1, wherein the CDMA receiving system includes an IS2000 1x CDMA base station receiver utilizing an array antenna.

9. (Original) A signal processing apparatus for enhancing a demodulation performance of CDMA receiving system utilizing an array antenna, the apparatus comprising:

means for producing array outputs, by means of products between a weight vector at present snapshot and each of Walsh demodulation outputs;

means for selecting an index number of an array output in such a way that a magnitude of a selected array output is largest of all array outputs; and

means for updating the weight vector by using a Walsh demodulation output vector which corresponds to the index selected in the means for selecting the index number.

10. (Original) The signal processing apparatus as recited in claim 9, wherein the Walsh demodulation outputs, $\{ \underline{x}_k \mid k = 0, 1, 2, ..., 63 \}$, are generated as results of 64 correlations of a received signal vector, with the 64 Walsh words defined in the CDMA receiving system, where N is the number of antenna elements in a given array antenna, such that each of the Walsh demodulation outputs can be written as $\underline{x}_0 = [x_{0,1} \ \ x_{0,2} \ \cdots x_{0,N}]^T$, $\underline{x}_1 = [x_{1,1} \ \ x_{1,2} \ \cdots x_{1,N}]^T$, ..., $\underline{x}_{63} = [x_{63,1} \ \ x_{63,2} \ \cdots x_{63,N}]^T$, where the component $x_{i,j}$ is obtained through the Walsh demodulation of the received signal with i_th Walsh word at the j_th antenna channel.

11. (Currently amended) The signal processing apparatus as recited in claim 9, wherein the means for updating the weight vector includes:

a ~~conversion~~ converting means for converting the index number of an array output ~~a quantity of the index ,D,~~ obtained from the means for selecting the index number into the corresponding 6-bit binary number in order to retrieve an original data transmitted from mobile terminal; and

a first updating means for updating the weight vector ~~$\underline{w}_D$,~~ based on ~~utilizing~~ the Walsh demodulation output corresponding to the index number of the array output ~~D,~~ ~~$\underline{x}_D$,~~in order to process the received signals for the next snapshot period.

12. (Currently amended) The signal processing apparatus as recited in claim 11[[12]], wherein the first updating means includes:

a second updating means for updating an autocovariance matrix of received signals with the Walsh demodulation output corresponding to the index number of the array output ~~D,~~ ~~$\underline{x}_D$,~~ such that the autocovariance matrix is determined by an equation as:

$$\underline{\underline{R}}_{xx} = E[\underline{x}_D \underline{x}^H{}_D]$$

where $\underline{\underline{R}}_{xx}$ is an autocovariance matrix, $E[\,]$ denotes an

expectation operator, D denotes an index number of an array output having a largest magnitude in all array outputs, x denotes a weight vector and super script H denotes a }-Hermitian operator; and

a computing means for computing an eigenvector corresponding to a largest eigenvalue of the autocovariance matrix obtained by the second updating means and use it as the weight vector.

13. (Currently amended) The signal processing apparatus as recited in claim 12, wherein the first updating means includes:

a second updating means for updating an autocovariance matrices of the received signals vector obtained before the dispreading procedure and the Walsh demodulation output after the despreading ~~dispreading~~ procedure through mathematical operations as:

$\underline{\underline{R}}_{rr} = E[\underline{r}\,\underline{r}^H]$ and

$\underline{\underline{R}}_{xx} = E[\underline{x}_D\,\underline{x}^H{}_D]$, respectively,

where the received signal vector obtained before the despreading ~~dispreading~~ procedure $\underline{r}$ is defined as $\underline{r} = [r_1\ r_2\ \ldots\ r_N]^T$ with the superscript T being the transpose operator and r_i being defined as the received signal at the i_th antenna element, i.e., $\{r_i = r_{I,i} + j\ r_{Q,i}$ for $i = 1, 2, \ldots, N\}$ and $r_{I,i}$ and $r_{Q,i}$, and the received signal vector $\underline{x}_D$ is itself the output of the Walsh demodulator; and

a third updating means for updating the weight vector with an eigenvector corresponding to a largest eigenvalue in a generalized eigenvalue equation consisting of the autocovariance matrices of received signals obtained before and after the despreading ~~dispreading~~ procedure through the mathematical operations as:

$\underline{\underline{R}}_{rr} = E[\underline{r}\,\underline{r}^H]$ and

$\underline{\underline{R}}_{xx} = E[\underline{x}_D\,\underline{x}^H{}_D]$, respectively,

as mentioned in the second updating means such that the weight vector $\underline{w}_D$ is eventually computed from the generalized eigenvalue equation, $\underline{\underline{R}}_{xx}\,\underline{w}_D = \lambda_{MAX}\,\underline{\underline{R}}_{rr}\,\underline{w}_D$, where λ_{MAX} denotes the largest eigenvalue of the given generalized eigenvalue equation.

14. (Original) The signal processing apparatus as recited in claim 9, wherein the CDMA receiving system includes an IS95 CDMA base station receiver utilizing an array antenna.

15. (Original) The signal processing apparatus as recited in claim 9, wherein the CDMA receiving system includes an IS2000 1x CDMA base station receiver utilizing an array antenna.

16. (Original) A computer-readable recording medium storing instructions for executing a signal processing method for enhancing a demodulation performance of CDMA receiving system utilizing an array antenna, the method comprising the steps of:

a) producing array outputs, by means of products between an weight vector at present snapshot and each of Walsh demodulation outputs;

b) selecting an index number of an array output in such a way that a magnitude of a selected array output is largest of all array outputs; and

c) updating the weight vector by using an Walsh demodulation output vector which corresponds to the index selected in the step b).

17. (Original) The computer-readable recording medium storing instructions for executing a signal processing method as recited in claim 16, the method further comprising the step of:

d) returning back to the step a) with a current value of the weight vector at the present snapshot being kept as an initial value to be updated at a next snapshot for continuing the signal processing method at the next snapshot, after the step c).